Planets Around Low-mass Stars - Theory

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Based of the sequential core accretion model for planet formation developed by Ida & Lin (2004, ApJ 604, 388), planetary systems around low-mass stars are discussed. Relatively low surface density of protoplanetary disks around low-mass stars tends to inhibit formation of massive cores and their low disk temperature tends to truncate gas accretion onto the planets at small masses. Both lead to significant depletion of Jupiter-size gas giant planets compared with solar-type stars, while Neptune-size icy planets can be brought to the proximity of host stars by type-II migration (Ida & Lin 2005, ApJ 626, 1045). Here, we also discuss the effects of type I migration of cores without opening up gaps in the disks. Even 10 times slower migration than predicted by the linear theory almost completely shuts down formation of gas giants around low-mass stars. As a result, mass distribution of close-in planets is very sensitive to type-I migration speed. Since our theoretical model predicts mass and period distribution of planets, it is directly compared with observation. We discuss observational tests for efficiency of type-I migration as well as that of gas accretion onto cores. We also discuss prediction of abundance of habitable planets by a combination of our theoretical model with radial-velocity observation from ground and future Kepler and SIM observations.